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ABSTRACT

This paper addresses the difficulty involved in creating easily understood information. The act of communicating is not complete until the message has been both received and understood by the audience. Messages must always be comprehensible, otherwise they will have no effect. The readability, legibility, and reading value of a graphic message is important to the receiver's ability to understand it. The following factors should be considered when formulating messages that are comprehensible: audience interpretation, recognition, and response to pictorial messages; the process of designing and creating integrated verbo-visual information; the quality of language; message clarity; credibility and esthetics; terminology; the reading process; and costs. Includes advice on good writing, the key to comprehensibility: analysis, preparation, writing, using pictures, and the final touch-up. (Contains 20 references.) (AEF)

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COMPREHENSIBILITY

by
Rune Pettersson

Some people are continuously in the process of creating documents such as PMs, messages, instructions, reports, descriptions, and course literature. Some of these documents are meant only for distribution within limited groups, while others will be spread to many different readers both inside and outside the company. However, because any author's intended message may be interpreted in different ways by different readers, problems arise. In some cases, readers do not understand the documentation at all.

It is difficult to create easily understood information. On the other hand, it is simple enough to require ease of comprehension. But what is actually implied when we say that a message is comprehensible?

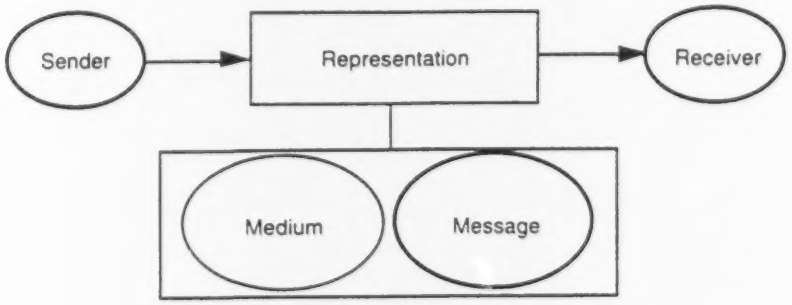
To someone working with information, it is not sufficient that a message be produced and transmitted, as in radio and television, nor is it sufficient that a message be produced, transmitted, and received by an audience. The act of communicating is not complete until our message has been both received and understood by the audience. In other words, our messages must always be comprehensible, otherwise they will have no effect.

Communication

Communication takes place when a sender wants to convey one or more messages to one or more receivers. The sender transfers the messages to the receivers with the help of different media. A medium and its contents (the message) constitute a *representation*.

In this report, I shall focus on formulating the message. As the reader will see, the discussion of comprehensibility is fundamentally applicable to all media.

On occasion, unfortunately, communication does not seem to function. This may depend on insufficient information, but it may also be because we have difficulty reaching each other. By way of example, the following title is cited as a warning in "The Technical Writer's Handbook" by Matt Young (1989): "Conditional symbolic modified single-digit arithmetic using optical content-addressable memory logic elements: Conditional symbolic modified signed-digit arithmetic operators" (p. 206).



Communication. A *representation* is a medium with a specific message. The sender transfers his message to the receiver with the help of a medium.

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Esoteric and impenetrable jargon like this can be perceived as incomprehensible by the uninitiated. Since readers who do not know the code are left out, its use poses the risk of "one-way only" communication, and has no value outside of initiated circles. We find it unsettling when experts speak down to us; it puts us into a defensive frame of mind, and may even cause us to become obstinate. Interaction analysts describe this as a "You're OK, I'm not OK" reaction. However, what we should be striving for is a "You're OK, I'm OK" situation.

When a document is to be read and understood by several people, there is ample reason to expend effort on achieving a good quality of information. When this is achieved, we can discern the information's esthetic, informative, pedagogical, and technical qualities, and sometimes even its entertainment value. Good information quality can be defined as the degree of congruity between the sender's and the receiver's subjective perceptions of the information, as well as of the reality that the information represents. By investing resources in improving the quality of information, we can achieve better product and project quality, while at the same time making large cost savings.

It seems as though arcane, abstruse texts have become a global problem in technical and scientific documentation. Kirkman (1992) opens the first chapter of his book "Good Style" with the following two paragraphs:

> It is surely axiomatic that the aim of technical writing is to transmit information accurately, quickly and economically from one person to another. Then why do so many scientists and engineers make their writing so heavily unreadable? Obviously, their subject matter is sometimes complex and conceptually difficult; but frequently the 'unreadability' stems from the use of a style that makes the reader's task much heavier than it need be. (p. 2)

Good documentation implies very good comprehensibility and low cost, as well as ready accessibility when it is needed--and only then, in fact. Poor comprehensibility causes the receiver's confidence in the sender to diminish, and heightens the risk of unsound decisions being made. Many good suggestions may be rejected because those whose job it is to determine their practical merit simply do not understand what the suggestions call for.

Comprehending means understanding the immediate or fundamental meaning of something. A message is comprehensible if it can be grasped without difficulty. Whether a message--for example, a technical report--can be understood or not is dependent on many different factors, of which some relate to the sender, others relate to the message or representation, and still others relate to the receiver (see the picture on the next page).

Speaking and writing are language-related activities performed by the sender. These activities are influenced by the sender's earlier observations, as well as by his terminology and the language he uses. Besides being *active*, the sender is in charge of *encoding* the message, i.e., its production and distribution.

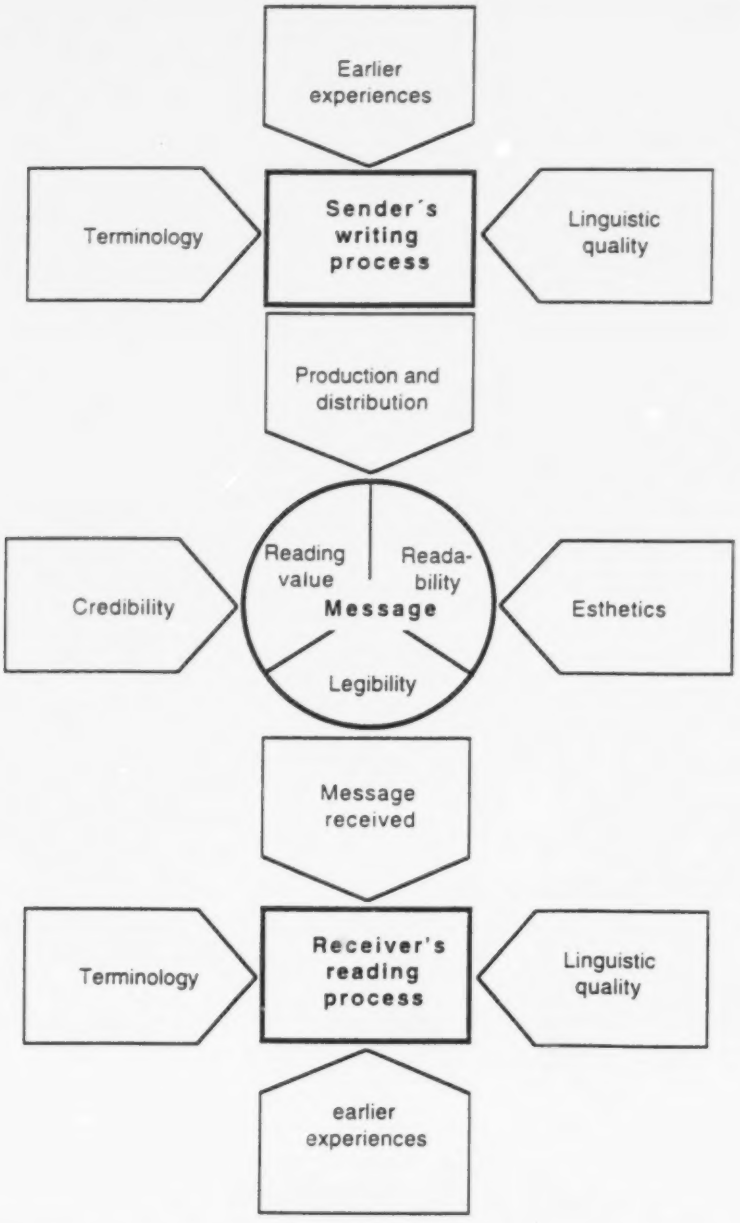
Listening and reading are language-related activities performed by the receiver. As is the case with the sender, the receiver's activities are influenced by his earlier observations, as well as by his terminology and the language he uses. Besides being relatively *passive*, the receiver is in charge of acception and *decoding* the message.

The picture on the following page shows a model of comprehensibility with a graphic verbo-visual message as an example. This model is also applicable to oral communication and communication via audio-visual media.

The readability, legibility, and reading value of the graphic message are of decisive importance to the receiver's

ability to understand it. (Audibility, distinctness, and listening value are of similar importance to the understanding of oral texts.) Moreover, these factors--besides being influenced by the writing process--are all prerequisites for the reading process.

Therefore, we shall attempt here to show the relation of readability, legibility, and reading value, as well as credibility and esthetics, to the message rather than to



Comprehensibility. Our ability to understand a verbo-visual message (for example, a technical report) is dependent upon its readability, its legibility, and its reading value. Comprehensibility is influenced by the message's credibility and esthetics, by the sender's writing process and the receiver's reading process.

the sender or the receiver. By proceeding from the writing process (i.e., the terminology of the message, as well as its credibility and linguistic value), we shall try to analyze how we can achieve greater comprehensibility.

It is clear that we must help those who work with documentation, information, and training to become better writers themselves, a goal that will also require the help of professional technical instructors, translators, graphics experts and designers. By developing explicit terminology, we can make things easier for writers as well as for their readers.

Experiences

Texts and pictures may be either easy or difficult to interpret. The degree to which they are one or the other can depend on several different factors. If, for example, a reader lacks the background knowledge in a given field that is required in order for him to interpret a text, then there is no chance that he will understand it, no matter how diligently the writers, instructors, graphics experts, and designers exert themselves. The same will be true if the reader's command of the language used is poor.

Everyone learns to read words, but we must learn to *read pictures* (Pettersson, 1989) as well. Therefore, pictorial *language* must be adapted to the viewer's capacity for interpreting it. Communication can be said to function successfully between the picture-maker and the viewer if the viewer understands, to the fullest extent, what the picture-maker wants the picture to say, and if the message conveyed is unambiguous.

Gunnarsson (1982) discusses specific reader characteristics from the perspective of the *schemata theory*, which is based on the premise that we store our impressions of our surroundings in the form of schemata. The theory postulates that we have different partial impressions, such as general knowledge about different types of text, as well as different whole impressions of reality. Our deeper understanding of a text is influenced by the schemata that we bring to the fore when we read.

A few brief glances at a picture are enough for us to recognize it again among other pictures. Shopping in a department store, for example, we are passively conscious, i.e., we know, that there are a great many advertisements in the form of pictures and text--and usually background music as well--all around us, even though it all fuses into something our senses perceive as noise. It is plausible that we process most of these stimuli at a superficial level: We see and hear, but we do not look or listen. To examine this more closely, let us imagine five cognitive mental levels arranged like the steps of a staircase (Pettersson, 1989):

- creating text, pictures, music
- analysing text, pictures, music
- reading text and pictures, listening to music
- looking at text and pictures, hearing music
- being aware of the presence of text, pictures, music.

Looking at a picture expends more mental energy and demands a higher cognitive level than merely seeing that a picture is there. Similarly, listening to music requires more concentration than hearing background music. These impressions, on being received, are conveyed from the sensory memory to the short-term or *working* memory. Some of the information proceeds on through the filtering system and becomes consciously perceptible to the receiver. However, after a short while, most of this information disappears.

When we study, we take an active part in the contents of the material. We read texts, we listen to music, we read pictures. This consciously perceived information is processed, sorted, and stored in certain parts of our long-term memory. In the case of a picture, we may need to focus on different portions of it a number of times (so-called *eye fixations*) to be able to describe it later on.

Conscious analysis of verbal messages requires even greater expenditure of mental energy and demands a still higher cognitive level. Most demanding of all are the creative processes that make it possible to create texts, music, and pictures. Authors, composers, and artists all bear witness to the mental strain that can be a part of the creative process. The cogniiive model with its five levels, as shown above, presupposes a dynamic mental process in which we change cognitive levels both consciously and unconsciously.

Our sensory organs react to changes in our surroundings. Normally, we can perceive changes (in spatial properties, for example) that are greater than about two percent. On the other hand, we adapt ourselves to slow, gradual changes, so that we barely notice them at all. Our normal condition, therefore, is a state of mental repose that affords us the capacity for sudden, rapid activity. Correspondingly, we cannot keep ourselves at the highest cognitive levels for more than a limited time; the effort would require too much energy and would probably induce some kind of mental *cramp*. Like a pike lurking among reeds, or a cat spying outside a mouse's hole, we know what our surroundings look like. If something happens to change some familiar element in our milieu, we can react swiftly and decisively, impelled by a rush of mental and physical energy. Sometimes things turn out fine: The pike gets his minnow, the cat gets her field mouse, and we find the information we are looking for. But things can turn into a muddle, too: The predators fail to capture their prey, and we end up wasting time and energy trying to make sense out of uninteresting information.

Because they influence us in an emotional way, pictures have an enormous impact. Children, for example, can be easily frightened by violent action on television, but they are not upset by reading about violent action in a book. This is in part because what we see seems more tangible to us than what we read, but it is also because reading a text requires a higher cognitive level than viewing a picture does. Several researchers, among them Tröger (1963) and Noble (1975), have demonstrated that very small children are incapable of taking an active part in the content, or understanding the context, of material shown on a television screen. Most parents with toddlers have made the same observation.

There are no fixed or distinct borders between the five levels of our cognitive model. Depending on cultural, social, and intellectual factors, there may be great differences between various persons' ways of conforming to the model. Then too, mood, health, surroundings, and a number of other circumstances can cause one and the same individual to react very differently at different times. However, what the model reveals is that there is in fact a great difference between the concepts of seeing--looking--reading and hearing--listening.

Actively taking part in a linguistic message that consists of text, sound or pictures, either together or separately, always implies the exertion of effort, i.e., work. Reading or listening taxes our faculties; sooner or later we become tired. Furthermore, material that is poorly constructed and/or presented strikes us as dull, and not only causes our interest in the subject to wane, but leaves us exhausted.

This applies irrespective of whether a message is meant to impart information, instruction, or entertainment. It also applies irrespective of the medium of conveyance, except insofar as different media have entirely different capacities for

conveying a message from a sender to a receiver.

Strömquist (1991) points out that we all have proficiency in, and insight into, the labours of writing. We all know how writing is done. We know that *the writing process* consists of more than simply committing words to paper; indeed, it presupposes long-term memory and familiarity with the things that have to do with writing. In other words, writing is an extensive, time-consuming, dynamic, gradual, cognitive, and strenuous business.

The Writing Process

The section *Writing Advice* contains concrete instructions, i.e., rules of thumb, on how to write so that your text will be understandable.

The physical act of writing down one's thoughts with the help of a pen or a keyboard does not usually require a great deal of time. It generally takes longer to think what the text should consist of than to formulate it. Thus, the writing process encompasses much more than merely writing, and it is relatively independent of the language used. We work more or less the same way when we write English as when we write Swedish or any other language.

Before we begin writing, we need to identify the subject and define the purpose of the message. This always requires analysis of the target group or receiver. Receiver analysis might contain evaluation of the receiver's basic understanding of the subject, his trade knowledge, experiences, skills, comprehensive capacity, attitudes, prejudices, motivation, linguistic competence, social background and vocation, as well as his age and the groups he belongs to or identifies with. Because all of these factors influence how the receiver takes in and understands a message, they are decisive to how we shall formulate the text.

To begin with, we shall need to gather and sort our material, as well as plan and outline our presentation. We need to choose the type-face, graphical form, and medium. It may be possible to use fixed writing patterns and established models.

When we have formulated the text, we shall need to process it and adapt it, so that it will suit our target group. We may have to rewrite the text as many as ten times before it is right. Although it may be true that even the most complicated texts can be presented in a comprehensible form, all writers need practice, practice, and still more practice. Liljestrand and Arwidson (1979) assert the following:

> Complicated texts are often defended on the grounds that their subject matter is complicated. In reality, however, the more difficult the subject is, the more one must attempt to express it in a comprehensible way. It is surely more reasonable to expect that someone who is writing for several people expend effort on the writing of his text, than that the various receivers be obliged, each on his own, to expend effort interpreting it! (p. 15)

Also Strömquist (1991)) maintains that everyone must practice writing to become good at it. Writing is a skill that we can learn. She says the following (in translation): "It is only by writing oneself that one can fully understand the complicated writing process; it is only by writing oneself that one discovers where the problem lies" (p. 35).

Texts may need to be augmented by the addition of pictures, for example, photographs or schematic diagrams. I often begin the work of writing by making a comprehensive picture, which sometimes develops into a short suite of pictures before I begin work on the text. Bergquist (1991) gives textbook authors five terse, vigorous instructions in the form of *commandments* (in translation):

- The first commandment: Don't write! Even if the author's first impulse is to start writing at once, it is essential to start writing at once, it is essential to begin with an outline.

- The second commandment: Use pictures! Get a picture to illustrate each section; wait with your text.

- The third commandment: Write captions for each picture! Each picture should have a relevant text, which may even have a heading.

- The fourth commandment: Talk to your editor! Together, the writer and the editor can expand a factual outline into a detailed outline for each layout. The outline contains room for both text and pictures.

- The fifth commandment: Write in a structured manner! The text should complement the pictures. Therefore, write in the space between the pictures. The editor provides the author with exact data about the number of strokes each line of text may fill.

The actual process of designing and creating integrated verbo-visual information is called *infography*. When text, picture, and graphic form are integrated into a fully delimited, structure surface (a functioning whole), the result is a graphical information entity, usually known as information graphics, that can be interwoven with texts and pictures in a information layout.

Quality of Language

There are several different subheadings under the general heading *quality of language*, among them, phonology, morphology, syntax, style, pragmatics, and infology.

- Phonology is the study of phonemes, i.e., the smallest units of semantic differentiation found in spoken language, and combinations of these units. The smallest written unit that fills a semantically differentiating function is called a grapheme.

- Morphology, the study of form or structure, deals with how words are formed and inflected.

- Syntax is the study of the rules for combining words into grammatical phrases, clauses, sentences, and paragraphs.

- Style is the way of expressing thought in writing or speaking by selecting and arranging words for clarity, effectiveness, and ease of reading.

- Pragmatics is, in linguistics, the study of the causal and other relations between words and how we connect words to express ourselves correctly.

- Infology is the study of how verbo-visual information is presented and read.

The way in which good quality of language is defined is, to some extent, dependent upon the purpose of the text. Technical writers, for example, are more consciously concentrated on getting results than other writers. Because technical language must be capable of effectively conveying as much information as possible to a certain group of readers, it is characterized in its ideal form by brevity, clarity, and precision (see the section on Technology).

According to Melin (1992), comprehensibility in a text is largely dependent upon perspective, abstraction, context, complexity, and redundancy. As it is, these qualities are themselves difficult to describe; small wonder, then, that the

comprehensibility of text defies assessment.

In an experiment, Kirkman (1992) allowed a group of people to rate six different versions of four technical and scientific texts. In terms of content, the texts were equal to each other, but they varied in their style of language. All told, some three thousand people took part in the experiment. In the case of all four texts, the test group rated the versions that were written in an active, direct, and personal style as being the most easy to read and understand. Contrarily, the versions written in a passive, indirect, and neutral style, with complicated sentence structure, were judged by the test group as being the most difficult to read and understand.

To describe the properties of text, the linguist works with advanced text analysis. However, it is relatively easy to describe a text's readability by using a readability index, a character index, and a nominal quotient.

The premises on which the readability and character indexes are based is that long words and sentences make a text difficult to read. The readability index is the sum of two calculations: the percentage proportion of long words (consisting of--depending on the language in question--the number of letters or syllables in a given word), and the average number of words per sentence. The readability index, while usually corresponding rather well both to people's subjective experience of a text's readability and to their results in comprehension tests, has received strong criticism because varied sentence length actually contributes to ease of reading.

The character index can be looked on as a visualization of the readability index. Each sentence is analyzed and noted on a chart depicting a system of coordinates, in which the y axis represents the number of long words and the x axis the number of words per second. Thus, by graphically providing more than a single mean, the character index offers more thorough information about a text than the readability index does.

The nominal quotient gives the total number of nouns, prepositions, and participles divided by the total number of pronouns, verbs, and adverbs. A good information text has a quotient of slightly more than 1.0. Text with a lower nominal quotient seems *chatty*, whereas text with a higher nominal quotient is cumbersome.

Research into readability has been directed towards finding the characteristics that make texts easy or difficult to understand. Gunnarsson (1982) points out that the psychological equivalent to *readability* is merely superficial understanding. Therefore, she prefers to use comprehensibility as the term for characteristics that are related to deeper, specific text understanding. Gunnarsson's theory of comprehensibility is based partly on the correlation between the level of understanding and the level of the text, and partly on the premise that what is read influences the reading process.

It is also possible to calculate the readability of pictures (Pettersson, 1989) by using the picture-readability index, which takes into account a picture's functional properties and expresses how easy or difficult the picture is to read. A picture that we are unable to understand cannot communicate any factual information. The easier it is to read a picture, the better it can convey information.

In the USA, there is an increasing incidence of lawsuits being brought against manufacturers. These suits claim damages as a result of accidents occurring or products breaking because of poor quality in the language of instruction manuals (Helyar, 1992). The courts are demanding that technical manuals, brochures, information sheets, labels, etc., be written in comprehensible language, and that descriptions and instructions be readable and legible. Everywhere, plaintiffs' counsels are searching

frenetically for sections of text and parts of pictures that might be interpreted in conflicting ways. If a manufacturer's technical documentation is difficult to understand, he can lose a lawsuit.

The Message

The message is the link between the sender and the receiver. The sender designs the message and sends it off. The receiver receives it, and tries to understand it.

Teleman (1991) points out that the systems of rules that govern spoken and written language are similar in many ways. Originally, writing was a way of depicting speech, but the two coded systems later went their separate ways. The most tangible feature of the rules for written language is their standardization. In most western countries, the written language is comprehensible throughout the country and does not reflect differences in dialect.

An essential difference between the spoken and the written message is the time available for transmitting them. The production of speech must take place in the here and now; the speaker and his listener communicate in real time. On the other hand, the writer and his reader can take all the time they need.

In the written message, legibility, readability, and reading value are vitally important to the message's comprehensibility.

Legibility

The graphical message's legibility is determined by the technical design of the text and the picture, i.e., their clarity. Legibility can be measured rather objectively, and its quality is assessable whether we understand its content or not. As far as the text is concerned, we should avoid unusual type-face, as well as type-face that is too small or too large.

We read each word in a text as a *picture*, not letter by letter. In a book it might be sufficient to set the type between nine and twelve points, although on a display screen, the text should be at least three to five times as large. The text on a poster meant to be read from some distance may need to be ten times greater in size.

Legibility in the written word is comparable to audibility in the spoken word.

Readability

The readability of the message involves the reader's ability to understand its text and pictures (compare the earlier section on the readability and character indexes and the nominal quotient). Readability is determined by the content and its presentation, and depends upon the degree to which it is adapted to the receiver's capacity to understand it. The writer and the picture-maker need to take into account the reader's knowledge, interests, and needs in order to compile, sort, and structure the material. This is also true with regard to the formulation of texts and pictures.

Readability in the written word is comparable to distinctness in the spoken word.

Reading value

The message's reading value is the receiver's subjective evaluation of the content of the text and pictures. What is interesting to one person can be deemed dull by another. We must therefore adapt text as well as pictures to be palatable to any given target group.

Reading value in the written word is comparable to listening value in the spoken word.

Pictures

When producing informative material, the sender always has a reason for adapting his message so that the receiver understands it. Pettersson (1989)

reports on a number of experiments in which altogether 4,350 people described how they interpreted the contents of different pictures. The experiments clearly showed that:

- How a picture is understood is a relative thing. Different people understand and describe the same picture in different ways.
- Even simple pictures need plain captions in order for the contents and presentation to be conveyable in verbal form.
- Pictures of abstract subjects are understood in considerably more varied ways than pictures with concrete subjects.
- Abstract subjects are described in concrete terms.
- The same intended theme or subject can be expressed through many different pictures.
- Texts and pictures are completely different *languages* that complement each other.
- The possibilities for combining texts and pictures are virtually unlimited.
- There is not likely to be just one but several equally good options available for achieving satisfactory communication.
- Pictures that will be used for information purposes should always be given captions that confirm the interpretation that is most relevant in the context.
- The interplay between text, picture, and graphic form needs to be studied thoroughly before optimal combinations can be found.
- We are able to differentiate between *immediate* and *analytical* understanding of pictures.
- We create a *pre-understanding* of how a picture should be interpreted based on the context in which the picture is shown.

Media

As a rule, the content of films and television programs is presented in a preordained fashion, which tends to encourage relative passivity in viewers. The same is true of prepared oral presentations.

The reader of a book digests textual and pictorial information at his own pace. If the information presented in the book has a structured surface, i.e., one in which the information is integrated into a single context, the reader can focus his attention relatively freely. The experience is akin to the way we take in information in real-life situations.

Interactive video programs make it possible to combine sound and moving pictures; thus, they can arouse considerable activity and commitment in the user. Because an interactive video program can stimulate the user to perform at a high cognitive level, it has the potential to function well, both as a conveyor of information and as a teaching aid.

Credibility and Esthetics

For a message to be effective, it needs not only to be credible but to merit credibility as well. First, its content must be correct and the quality of its text and pictures beyond reproach. Convincing arguments, proper references, and relevant examples are other requirements, as is presentation of the message in concrete--as opposed to abstract--terms. Credibility can also be influenced with the help of typography and layout.

The National Swedish Psychological

Defence Planning Committee has carried out comprehensive studies of various media's credibility (Arvidson, 1981; Törnqvist, 1974). Receivers of information evaluate credibility according to how they perceive the straightforwardness, the factual content, and the comprehensibility of the message.

Thus far in these tests, ether media have always won the greatest credibility. At the end of the 60s, television was considered superior in credibility, although by the beginning of the 70s, radio was considered most credible. During the 80s, radio and television were felt to be equal in credibility; fully 80% of those questioned were in accord with this. However, it does not seem as though people in Sweden trust the information found in newspapers. In the autumn of 1981, slightly more than 10% judged the morning papers to be *most credible*, while only 1-2% made that assessment of the evening papers' information.

It is primarily the younger generation who have the most faith in television. The older we are, the more credible we find the morning papers. Furthermore, trust in the morning papers is greater the higher our level of education is.

Material with a (sufficiently) pleasing esthetic form has greater potential for conveying a particular message than does unaesthetic material (Pettersson, 1989). The sender's choice of graphical form will generate either positive or negative expectations in the receiver, while the choice of typography and layout can often give the reader a pre-understanding of the message's content.

In other words, it is important that a visual message exhibit good legibility, or, it it is a spoken message, distinctness. The message may be esthetically pleasing, but its content is more important than its form.

Terminology

There are as many different varieties of shop-talk, i.e., trade jargon, as there are vocational fields. In technical reports, for example, one finds far more detail and uncommon wording than in the language at large.

Terminology, the study of terms, encompasses terms, concepts, idioms, definitions, references, conceptual systems, and semantics. A term is a word or expression for a particular concept found in a given field of work, in which it has a specific and carefully determined meaning. A concept is an idea of something formed by mentally combining all its characteristics or particulars. An idiom is a fixed expression whose meaning is not discernible from the definitions of the individual words of which the expression is made up. A definition is a description of a concept rendered in words. A referent is an object, abstract or concrete, for which a name or designation stands. A conceptual system, or a conceptual hierarchy, is a systematic description of the relations between the various concepts in a particular area of thought. Semantics is the study of the meaning of verbal expressions and the implications of combinations of words.

The subjects lexicology and lexicography also belong to this area. Lexicology is the science that deals with the structure of vocabulary. Lexicography is both the study of how dictionaries are compiled and the actual process of compiling and writing them.

The Reading Process

Both the reading and the listening processes require decoding of symbols, pre-understanding of words, phrases, and pictures, and, finally, comprehension of the content of the information. Furthermore, as we mentioned before, the legibility, readability, and reading value of the written message influence the reading process. In the case of the spoken message, the message's audibility, distinctness, and listening value influence the hearing process.

As far as the receiver of the message

is concerned, the following are some of the factors that greatly influence his intake of information:

- Earlier experiences and observations.
- Perception.
- Learning.
- Memory.
- The reading objective.
- The reading procedure.
- Pre-understanding.

Memory

Reading texts and pictures, and actively listening, are dependent on our short-term memory, as is all mental activity. Only a certain limited amount of information can be contained in the short-term memory at any time. New information crowds out information that is older than about a second, and the older information easily disappears if we are not prepared to store it in our long-term memory. If we repeat the information a few times, we increase our chances of remembering it. Long, complex words in a text are not immediately apparent to us, our short-term memory becomes overloaded with long chains of words that cannot be directly put into a meaningful context.

The Reason for Taking in the Information

Gunnarsson (1982) discusses five different categories of reading objectives. What differentiates them is the kind of stored knowledge that must be invoked in order for understanding to take place. Of course these categories are not sharply delimited, but overlap.

- In memorization of the textual surface, the objective is to create a visual memory of the text's surface.
- In registration of the text's content as such, the objective is to understand the written message's structural and conventional importance.
- In comprehension of the sender's description of reality, the objective is to understand what the sender means by the text.
- In integration of the text into one's perception of one's own surroundings, the objective is to integrate the text into one's own earlier experiences and observations.
- In direct, action-related comprehension, the objective is to know how one should behave in different situations, based on what the text says.

The first objective involves reading in order to recognize each word and memorize the text surface, while the second requires us to read and understand the words in the text. With objectives three to five, reading is directed towards individual sentences, parts, and the whole of the text, and other proficiencies and ideas are brought to bear on the material. Objective three, for example, obliges the reader to interpret the text in terms of the sender's situation. Objectives four and five require that he interpret the text in terms of his own surroundings and world view.

Möijer (1987) states that we read in different ways depending on what purpose our reading serves. We read intensively, every word and line, when our purpose demands it. We skim if we only wish to quickly get some idea of the material. We read to orient ourselves if we want to know where in a text some particular information is found. We read to inform ourselves when we need certain limited

information. In each of these cases, we leave out anything that does not directly satisfy the purpose of our reading.

Different reading objectives (Gunnarsson, 1982) or purposes (Möijer, 1987) attached to reading give rise, therefore, to different reading purposes. These purposes differ in terms of the level of text on which the reader focuses, and in terms of how the material is processed.

The Reading Procedure

According to Gunnarsson (1982), the reading procedure is of great importance to the reader's capacity for understanding a text. In *normal reading*, we direct our attention towards how we shall interpret the meaning of a sentence. Studying the syntax becomes subordinate to orienting our thoughts amid the semantic and pragmatic relations that form the text's warp and woof. When we read long continuous texts, we process separate sentences with an eye to their integration into the material's entirety. This takes place gradually, with the text that we have already read providing the framework. Text comprehension is a constructive process, in which the reader builds up his perception of the whole by integrating the text with his own experiences.

Pre-Understanding

An important step in the reading process is pre-understanding (Pettersson, 1989). As I mentioned before, the graphical form of a text creates expectations in the reader regarding its content. We expect certain types of documents to look a particular way; contrarily, when we see a document of a certain type we expect a particular type of text and pictures to accompany it. Thus, it is in the light of these expectations that we activate the cognitive processes needed to interpret the message.

The reader develops his own methods for predicting what a text will be about. Introductions, abstracts, tables of contents, summaries, illustrations, and tables all have important functions to fill.

Television producers are usually good at showing what their programs are about. In countries with a great many television channels, it has been noted that viewers switch rapidly between different channels until they find program that awakes their interest. Sometimes a viewer will make up his mind within the space of a couple of seconds (Matsushita, 1988).

Language that is rich in similes and metaphors makes it easier for the reader to paint his own inner pictures. A well constructed text with clear, distinct arrangement and lucid paragraph disposition, organized under well formulated headings and captions, affords the best reading experience.

Costs

When a great many people are required to read and understand information during working hours, the cost incurred is great. It can be expensive to produce information, but it costs even more to store, find, and use it. The greater number of individuals who must partake of certain information, the greater the cost will be. The cost of reading is determined by the type of documents that will be read, as well as by the groups that will read them. Thus, presenting information in a suitable way offers great opportunities for saving money. In the handbook called "Plain Talk from the Cabinet Office," that is provided for use by members of that body, Ehrenberg-Sundin (1982) states that judicious planning of texts can save millions. She writes as follows (in translation):

> It is expensive to read texts! The cost of reading is often many times greater than the cost of writing and printing the material. Besides, if readers do not understand the text, or if they interpret it incorrectly, it becomes VERY expensive! This problem can be solved by planning text better. It should have a purpose and the selection of its content must

> agree with that purpose. Thus, we can avoid the greatest reading expenses. If we help the reader further by writing comprehensible language and giving the text a sensible presentation as well as an arrangement that is logical to him, we shall have saved still more time and money.

The cost of reading and understanding text is in most cases many times greater than the cost of producing it. Ehrenberg-Sundin (1982) offers an estimate:

> For a report that has cost SEK 80,000 to print and just as much to write (four months' salary for a committee secretary), the cost of reading it will be SEK 1,600,000 if 1,000 persons spend eight working hours each (at SEK 200 per hour) to read and understand it.
> The greater the number of people who are meant to read a text, the greater the incentive is to expend extra effort on making it easy to read!

In private companies, the cost per hour is usually reckoned at SEK 400 or more, instead of SEK 200. (Since 1982 these costs have increased considerably due to inflation; however, the rations remain the same.) Thus, in industry, savings in this area can be still greater than they might be in the public sector.

Melin (1986), and others refer to a cost estimate that was carried out at the Swedish Telecommunications Administration (Televerket). The total cost of a 20-page technical report was estimated in SEK per page as follows:

Writing	5.60
Printing	1.40
Storage	25.00
Reading	225.00

In other words, the cost of reading the report was many times greater than all the other costs put together. The author's work on the text represented only two percent of the total cost.

Writing Advice

Against the background of the previous discussions (regarding comprehensibility, communication, experiences, the writing process, quality of language, message clarity, credibility and esthetics, terminology, the reading process, and costs), it is possible to give some concrete advice, or rules of thumb, on good writing strategy as the key to good comprehensibility. These rules of thumb, besides being written so that any writer can easily follow them, are divided into the following sections: Analysis, preparation, writing, using pictures, and doing the final touching-up. In some places, references to relevant literature are given, if you want to penetrate the material more deeply.

Analysis

- Investigate who will read your text.
- What characteristics do the readers have?
- What is the purpose of your message? Do you want to inform, give instructions, or influence your readers?
- Are the readers positively or negatively disposed to your message? What are their expectations?
- How will you convey your message to the readers? What medium or media will you use?
- What financial conditions or limitations apply to your work?
- What external factors can influence how the readers will interpret your message?

Preparation

- When you create a message, always proceed from what you yourself know about the readers. What is the readers' level of knowledge?
- Draw up a preliminary plan for your writing. Allot sufficient time for it.
- Gather material, for example, by reading, interviewing people, making observations, and performing experiments.
- Collect the pictorial material (see Using Pictures below).
- Sort out the material that will be included with your text. Proceed from what you know about the readers' potential for understanding it. Focus on the most important aspects.
- Structure your material. Make an outline of your subject; it can later be refined and given more detail. A technical report should have a title, a table of contents, an abstract or summary, an introduction, description, an analysis, a conclusion (including your own viewpoints), and a list of sources or references. Avoid footnotes and appendices, as they are seldom read.
- There are different types of outlines, for example, narrative and logical outlines. Do not switch between different types in the same document.
- Write an interesting title and, if you like, a subtitle.
- Choose a graphical form that suits the material. It will make things easier for the readers if information of the same kind is presented in a similar way. A well-thought-out graphical form contributes to the readers' understanding.

Writing text

General

- Let your writing be simple, clear, and concise. Express yourself in specific rather than unspecific terms.
- Use a style that is natural for you. Avoid both colloquial language and excessively formal constructions.
- Analyze, argue, describe, compare, refer, make associations, spin a tale, all according to what you think is needed.
- Try not to insinuate subjective values into your text. If is is your own opinion you are expressing, make this plain.
- Avoid writing in a style that is to laconic or sterile, but don't allow yourself to become *chatty*. Sentences that are too dense, i.e., sentences in which too many ideas are concentrated, will make your text tedious reading.
- Use aids, such as dictionaries and encyclopedias. For a guide to English writing, see the Economist (1991) "Style Guide," "Good Style" by Kirkman (1992), and "The Elements of Style" by Strunk and White (1979).

Words

- Avoid long, polysyllabic, complicated words.
- Avoid buzz-words, slang, and

expert jargon.

- Use defined, established terminology. If you are obliged to use abbreviations, define them in full the first time they appear in text.

Sentences

- Try to have your sentences say one thing at a time, don't cram them with ideas. In general, try to vary the length of your sentences to increase reading ease, but avoid sentences that are too short or too long.

- Avoid complicated word order and subordinated clauses. Be particularly careful in your placement of modifiers. Avoid the passive voice ("The B process is affected by A"); write active sentences ("A affects the B process"). Use verbs instead of nouns and gerunds.

Paragraphs

- Let every paragraph encompass a single unit of content. Avoid long, convoluted paragraphs that meander in all directions.

- Link sentences and paragraphs with conjunctions and/or adverbs (and, nevertheless, moreover, because, but, however, therefore, although, because, since, or even, thus), making sure at the same time that the things linked together bear a logical relation to each other. In the sentence "the project was terminated due to calculated project costs and more profitable use of resources, the phrase terminated due to" implies that whatever is to follow will have had a negative effect on the project's progress. However, "calculated project costs" and "more profitable use of resources," besides being neutral rather than negative in effect, have no logical relation to each other, nor do they tell why the project was terminated. The sentence should read: "The project was terminated due in part to project costs being calculated as excessive, and in part to the necessity of putting resources to more profitable use."

The Entire Piece

- There should be a *red thread* running through the text. Try to find a unifying principle. Clearly show what it is that you want to express.

- If the subject is on a high plane of abstraction, use concrete examples that illustrate the principles.

- Use similes and metaphors. They make it possible for readers to paint an inner picture.

- If the text shows a high degree of specification and examines a great many separate details, you should summarize every now and then, and draw conclusions.

- Sometimes you may find it necessary to write your foreword, introduction, and summary after the body of the piece is written.

- List your references clearly.

Using Pictures

- Use pictures to make it easy for the reader to understand your message.

- Any pictures you use should be clear and easily read. Pictures

should always have captions.

- Pictures and text must interact to produce a seamless unity.
- Place texts and pictures that belong together as close to each other as possible.
- Do not change the content of a picture by using different forms of computer manipulation. This practice is often unlawful, and always unethical.
- Never try to pass off unauthentic pictures as being true depictions of reality.
- The source of any borrowed pictures should be identified.
- For a guide to visual language see "Visuals for Information. Research and Practice" (Pettersson, 1989).

Doing the Touching-Up

- Let your text *rest* for a week or so, then read it from the reader's point of view. Make the necessary amendments.
- Check that the finished text corresponds to the text as you had planned it.
- Edit your text! Polish it. Trim away any unnecessary bulk. Iron out inconsistencies. Simplify the language. Clean up the punctuation. Every sentence should be easy to read!
- Check style and grammar. Discrepancies in grammar and style hinder the reader's progress and make the writer less credible in his eyes.
- Check spelling and word division at the end of lines. In some cases, functions in your word processing program can help you with this.
- Check your references and other formal aspects of your paper.
- Refine the typography and layout so that the headings, tables, and pictures are presented in a lucid, esthetically pleasing graphical form. Make optimal use of the possibilities that typography offers.

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